AMENDMENT TO THE CLAIMS

In The Claims

A listing of claims follows:

1. (Currently Amended) An apparatus comprising:

a wavelength division multiplexing optical network including optical network devices, coupled by links, that participate in a distributed search base scheme to discover and maintain network topologies that comprise possible end to end paths for each of the optical network devices to all other reachable optical network devices in the optical network as destination nodes, wherein said distributed search base scheme includes propagation of connectivity request messages initiated at each of said optical network devices acting as access nodes and receipt of messages that each carry end to end path identification information back to the originating access nodes ~~transmitted from an optical network device in that end to end path that is coupled to a destination optical network device of that end to end path~~, wherein the end to end paths include paths that are a series of three or more of said optical network devices connected by links on which a set of wavelengths is available for establishing a lightpath, wherein allocated and unallocated wavelengths are considered available, and wherein the set of wavelengths on an end to end path includes at least those wavelengths common on all of the links of that end to end path; and

said optical network devices acting as access nodes each creates and maintains, responsive to receipt of the messages that include the end to end path identification information, a network topology database, which represents

the network topology for that access node, through sustained storage of the possible end to end paths, with costs, from that access node to all other reachable destination nodes, each of said paths in said databases having associated with it the wavelengths available on that path, wherein the possible end to end paths in each of said databases are organized such that all available paths to each of the reachable destination nodes are grouped together under that reachable destination node, wherein at least one of said databases stores at least two different groups of available paths to at least two different reachable destination nodes, and wherein said databases are not specific to or created responsive to receipt of a request to allocate a lightpath~~path request messages~~.

2. (Previously Presented) The apparatus of claim 1, wherein each of said databases stores said available paths sorted in each group at least in part by the cost.

3. (Canceled)

4. (Previously Presented) The apparatus of claim 1, wherein said available paths are paths for one or more of optical circuits, lightpaths, and end-to-end unidirectional paths.

5. (Previously Presented) The apparatus of claim 1, wherein each of said paths represented in each of said databases is a sequence of optical network devices and interconnecting links.

6. (Canceled)

7. (Previously Presented) The apparatus of claim 1, wherein said optical network devices acting as access nodes each also includes:

a regular path module to select from said paths a path and an unallocated wavelength thereon.

8. (Previously Presented) The apparatus so claim 1, wherein said optical network devices acting as access nodes each also includes:

a disjoint path module to, based on an input path and said database, select from ones of said paths a disjoint path and an unallocated wavelength thereon.

9. (Previously Presented) The apparatus of claim 8, wherein each of said disjoint path modules is at least to determine at least one of fully node disjoint type paths and maximally node disjoint type paths.

10. (Previously Presented) The apparatus of claim 8, said each of disjoint path modules is at least to determine at least one of fully link disjoint type paths and maximally link disjoint type paths.

11. (Previously Presented) The apparatus of claim 1, wherein said optical network devices acting as access nodes each also includes:

a demand module to respond to requests for paths received by said access node;

a path selection module to, based at least in part on input destination nodes, select paths from the paths in said database associated with the input destination nodes and select unallocated wavelengths on said selected paths; and

an allocate module to cause allocation of said selected paths and wavelengths in real time.

12. (Previously Presented) The apparatus of claim 1, wherein each of said optical network devices acting as an access node builds and maintains said database.

13. (Previously Presented) The apparatus of claim 1, wherein each of said optical network devices, responsive to each received connectivity request message initiated by others of the optical network denies acting as access nodes, to determine any adjacent optical network devices to which an identified possible end to end path that the received connectivity request message has already collected can be extended to form additional possible end to end paths having a different originating access node as the source node, to transmit the message carrying that determination back to the originating access node of the connectivity request message responsive to which that message was generated for storage in the database of that node, and to propagate an updated version of said received connectivity request message to any adjacent optical network devices that may be able to determine further additional possible end to end paths having the originating access node as the source node.

14. (Currently Amended) An apparatus comprising:

an access node, to be coupled in a wavelength division multiplexing optical network, including,

a network topology database to store a representation of paths from the access node to all other reachable access nodes in said optical network as destinations, wherein said representation to separately store the following,

a destinations structure to store each of said destinations in a single entry,

each of said destination's single entry to reference paths to that destination, wherein each of said paths is represented in

said database by a cost and a series of three or more nodes and interconnecting links over which that path travels, and wherein said database stores at least two different groups of paths to at least two different reachable access nodes, and

the sets of available wavelengths wherein each of said paths to reference a set of wavelengths available on that path; and

a path selection module to select from said database ones of said paths and unallocated wavelengths thereon; and

a database module that creates and maintains said database responsive to receipt of messages that each include end to end path identification information ~~transmitted from a node in that end-to-end path that is coupled to a destination node of that end-to-end path~~, wherein said database is not specific to or created responsive to receipt of a request to allocate a lightpath~~path request messages~~.

15. (Canceled).

16. (Canceled)

17. (Previously Presented) The apparatus of claim 14, wherein said paths are paths for one or more of optical circuits, lightpaths, and end-to-end unidirectional paths.

18. (Canceled)

19. (Previously Presented) The apparatus of claim 14, wherein each of the sets of wavelengths is a path channel set that includes one or more wavelengths common to all of the interconnecting links of its path.

20. (Previously Presented) The apparatus of claim 14, wherein said path selection module comprises:

a regular path module to select from said paths a selected path and an unallocated wavelength thereon.

21. (Previously Presented) The apparatus of claim 14, wherein said path selection module comprises:

a disjoint path module to, based on an input path having a given one of said destinations, select from ones of said paths a disjoint path and unallocated wavelength thereon.

22. (Previously Presented) The apparatus of claim 21, wherein said disjoint path module is at least to determine the intersection of the intermediate nodes of said input path and the intermediate nodes of a candidate path in said database that has the same source and destination nodes as said input path.

23. (Previously Presented) The apparatus of claim 21, said disjoint path module is at least to determine the intersection of the interconnecting links of said input path and the interconnecting links of a candidate path in said database that has the same source and destination nodes as said input path.

24. (Previously Presented) The apparatus of claim 14, wherein said access node further comprises:

an allocate module, coupled to said path selection module, to cause allocation of paths and wavelengths thereon in real time.

25. (Previously Presented) The apparatus of claim 24, wherein said access node further comprises:

a demand module, coupled to said path selection module and said allocate module, to respond to requests for paths received by said access node.

26. (Previously Presented) The apparatus of claim 14, wherein said access node includes additional modules to build and maintain said database in said access node.

27. (Previously Presented) The apparatus of claim 26, wherein said access node employs a distributed search based scheme to build and maintain said database.

28. (Previously Presented) The apparatus of claim 14, wherein said access node further comprises:

a start up module to generate and transmit to adjacent nodes connectivity request messages to determine undiscovered possible paths having said access node as a source node and meeting a set of zero or more connectivity constraints; and

a connectivity request module, responsive to each received connectivity request messages originated by the other access nodes, to determine any adjacent nodes to which an identified possible path that the received connectivity request message has already collected can be extended to form additional possible paths having the originating access node as the source node, to transmit a message carrying that determination back to the originating access node of the received connectivity request message, and to propagate an updated version of said received connectivity request message to any adjacent nodes that may be able to determine further

additional possible paths having the originating access node as the source node.

29. (Previously Presented) The apparatus of claim 28, wherein said start up module is also to build said database responsive to receiving the messages carrying determinations of additional possible paths having the access node as the source node.

30. (Previously Presented) The apparatus of claim 14, wherein said access node further comprises:

a module to build said database based upon data collected by OSPF.

31. (Previously Presented) The apparatus of claim 14, further comprising:

a centralized network management server communicatively coupled to said access node to build and maintain the database.

32. (Previously Presented) The apparatus of claim 14, wherein said access node further comprises:

a link state database to store, for each link connected to said access node, a link state structure to store a port of the access node to which that link is connected and available wavelengths on that link; and

a link protocol module to populate said link state database.

33-69. (Canceled)

70. (Currently Amended) A method performed in an access node of a wave division multiplexing optical network, said method comprising:

locating a reachable destination node in a structure of a database, wherein said structure stores a non-duplicative set of the plurality of destination nodes in the optical network, wherein each of said plurality of reachable destination nodes in the structure references a group of available paths to that destination node, an available path comprising a sequence of three or more nodes and interconnecting links of those of the available paths that lead to that destination node and the all of the available paths in each group sorted at least in part by cost, each such available path having associated to it the set of one or more available wavelengths along that path to here; and wherein said database stores at least two groups of the available paths to at least two different reachable destinations, and

accessing from the database the nodes and/or links of a selected one of the available paths associated with the located one of said plurality of destination nodes;

selecting from the database an unallocated one of the set of available wavelengths along the selected path, wherein allocated and unallocated wavelengths are considered available wavelengths and, wherein the set of wavelengths on each of the available paths includes at least those wavelengths common on all of the links of that available path; and

creating and maintaining said database responsive to receipt of messages that each include end to end path identification information ~~transmitted from a node in that end to end path that is coupled to a destination node of that end to end path~~, and wherein said databases are not specific to or created responsive to receipt of a request to allocate a lightpath ~~path request messages~~.

71. (Previously Presented) The method of claim 70, wherein said method further includes:

determining that the accessed nodes and/or links are sufficiently disjoint from a set of input nodes and/or links to meet a set of disjointness constraints.

72. (Previously Presented) The method of claim 71, wherein the set of disjointness constraints includes one of fully node disjoint, maximally node disjoint, fully link disjoint, and maximally link disjoint.

73. (Previously Presented) The method of claim 70, wherein said available paths are for lightpaths.

74. (Previously Presented) The method of claim 70, wherein said available paths are optical circuits.

75. (Previously Presented) The method of claim 70, wherein the database includes for each of the sets of wavelengths a status for each wavelength, wherein said status includes allocated and unallocated states.

76. (Currently Amended) A method comprising:

transmitting to each adjacent node of an access node of a wavelength division multiplexing optical network a connectivity request message to be propagated to determine possible end to end paths from said access node as a source node to a plurality of other reachable access nodes in said optical network as destination nodes, wherein an end to end path is a series of three or more of nodes connected by links on which a set of wavelengths is available for establishing a lightpath, wherein allocated and

unallocated wavelengths are considered available wavelengths, wherein the set of wavelengths on an available path includes at least those wavelengths common on all of the links of that available path; and

receiving responsive connectivity messages identifying collected possible end to end paths and a path channel set for each identifying the available wavelengths, wherein each of the received responsive connectivity messages include end to end identification information ~~transmitted from a node in that end to end path that is coupled to a destination node of that end to end path~~;

responsive to receiving the response connectivity messages, creating and storing in a database, by the access node, the collected end to end paths, the collected end to end paths organized in the database such that all available paths to each of the destination nodes are grouped together under that destination node, and the database stores at least two groups of the available paths to at least two different destinations, wherein said database is not specific to or created responsive to receipt of a request to allocate a lightpath~~path request messages~~;

storing in said database the path channel set for each of the collected end to end paths;

associating in said database each of the stored path channel sets to the corresponding stored end to end path.

77. (Previously Presented) The method of claim 76, wherein said storing includes in said database the collected end to end paths further comprises:

associating a cost to each of said end to end paths; and

sorting the end to end paths in each group at least in part by said costs.

78. (Previously Presented) The method of claim 77, further comprising:

responsive to a demand for a path to a given destination node, performing the following,

selecting the group of sorted end to end paths with the destination node; and

selecting a path with an unallocated wavelength from the selected group of sorted end to end paths having the given destination node; and

selecting a wavelength on the selected path.

79. (Previously Presented) The method of claim 77, wherein said selecting said path further comprises:

selecting the first path in the sorted order with an unallocated wavelength.

80. (Previously Presented) The method of claim 77, wherein said selecting said path further comprises:

accessing from the database the nodes and/or links of the selected path; and

determining that the accessed nodes and/or links are sufficiently disjoint from a set of input nodes and/or links to meet a set of disjointness constraints.

81. (Previously Presented) The method of claim 80, wherein said set of disjointness constraints include one or more of maximally link disjoint, fully link disjoint, maximally node disjoint, and fully node disjoint.

82. (Previously Presented) The method of claim 77 further comprising:

responsive to a demand for a path to a given destination node, performing the following,

selecting the group of sorted end to end paths with the given destination node;

selecting as an initial path the first path with an unallocated wavelength from the selected group;

selecting as a subsequent path the first path with an unallocated wavelength from the selected group whose nodes and/or links are sufficiently disjoint from the nodes and/or links of the initial path to meet a set of disjointness constraints; and

selecting an unallocated wavelength on said initial path; and

selecting an unallocated wavelength on said subsequent path.

83. (Previously Presented) The method of claim 82, wherein said set of disjointness constraints include one or more of maximally link disjoint, fully link disjoint, maximally node disjoint, and fully node disjoint.

84-88. (Canceled)

89. (New) The apparatus of claim 1, wherein the messages that carry end to end path identification each originate from an optical network device in the identified end to end path that is coupled to the destination optical network device of that end to end path.

90. (New) The apparatus of claim 14, wherein the messages that include end to end path identification each originate from a node in the identified end to end path that is coupled to the destination node of that end to end path.

91. (New) The method of claim 70, wherein the messages that include end to end path identification each originate from a node in the identified end to end path that is coupled to the destination node of that end to end path.

92. (New) The method of claim 76, wherein the response connectivity messages each originate from a node in the identified end to end path that is coupled to the destination node of that end to end path.

93. (New) The apparatus of claim 1, wherein the messages that carry end to end path identification each include a plurality of end to end paths.

94. (New) The apparatus of claim 14, wherein the messages that include end to end path identification each include a plurality of end to end paths.

95. (New) The method of claim 70, wherein the messages that include end to end path identification each include a plurality of end to end paths.

96. (New) The method of claim 76, wherein the response connectivity messages each include a plurality of end to end paths.